WHAT IS CLAIMED IS:

1. A self-adaptive graphic equalizer operable to equalize the affects of an audio system on an audio signal, comprising:

Sub B1

an adaptive graphic equalizer having a plurality of equalizing filters, the plurality of equalizing filters having different center frequencies and spanning a predetermined audio bandwidth, each equalizing filter being operable to filter an i^{th} sub-band of the audio signal;

a plurality of first filters coupled to the audio system, each first filter being operable to filter an i^{th} sub-band of an output signal of the audio system;

a plurality of second filters receiving the audio signal, each second filter being operable to filter an i^{th} sub-band of the audio signal; and

a gain adjuster operable to adjust the i^{th} sub-band of the adaptive graphic equalizer in response to a difference in the i^{th} sub-band of the filtered output signal from the plurality of first filters and the i^{th} sub-band of the filtered audio signal from the plurality of second filters.

2. The self-adaptive graphic equalizer, as set forth in claim 1, further comprising:

a first plurality of lowpass filters, each lowpass filter being operable to filter an i^{th} sub-band of the filtered audio signal;

a second plurality of lowpass filters, each lowpass filter being operable to filter an i^{th} sub-band of the filtered output signal;

Sub B1

a mean normalization circuit operable to normalize the i^{th} sub-band lowpass filtered audio signals and the the i^{th} sub-band lowpass filtered output signal and generate an i^{th} sub-band of mean-normalized audio signal and an i^{th} sub-band of mean-normalized output signals.

3. The self-adaptive graphic equalizer, as set forth in claim 2, further comprising:

a comparator coupled to the mean normalization circuit and operable to determine whether the i^{th} sub-band lowpass filtered output signal is less than the i^{th} sub-band of mean-normalized audio signal; and

the gain adjuster of the i^{th} sub-band of the graphic equalizer operable to increment or decrement the gain of the i^{th} sub-band of the graphic equalizer in response to the comparator comparison.

4. The self-adaptive graphic equalizer, as set forth in claim 2, further comprising:

a difference circuit coupled to the mean normalization circuit and operable to determine the difference between the i^{th} sub-band lowpass filtered output signal and the i^{th} sub-band of mean-normalized audio signal; and

the gain adjuster of the i^{th} sub-band of the graphic equalizer operable to add or subtract the difference from the gain of the i^{th} sub-band of the graphic equalizer.

5. The self-adaptive graphic equalizer, as set forth in claim 1, further comprising:

a time averaging circuit coupled to the plurality of first filters and the plurality of second filters and operable to compute time averages of the plurality of filtered output signals and the plurality of filtered audio signals;

a dB converter coupled to the time averaging circuit operable to convert the time averaged plurality of filtered output signals and the time averaged plurality of filtered audio signals to dB space; and

a normalization circuit receiving the time averaged plurality of filtered output signals and the time averaged plurality of filtered audio signals in dB space, and adjusting the signals so that:

$$\sum_i r_{Li} = \sum_i o_{Li}$$

where r_{Li} is the time averaged i^{th} filtered output signal in dB space, and o_{Li} is the time averaged i^{th} filtered audio signal in dB space.

6. The self-adaptive graphic equalizer, as set forth in claim 1, wherein the adaptive graphic equalizer comprises ten overlapping sub-bands, each sub-band having filters between ±18 dB.

Sub B1

7. The self-adaptive graphic equalizer, as set forth in claim 1, wherein the plurality of first and second filters each comprises bandpass filters.

8. The self-adaptive graphic equalizer, as set forth in claim 1, wherein the audio system is a speaker-microphone combination system.

Sub B'

9. A digital self-adaptive graphic equalization method to equalize the affects of an audio system on an audio signal, comprising:

receiving an output signal from the audio system, the output signal being generated by the audio system in response to the audio signal;

dividing the output signal into N sub-bands and filtering an i^{th} sub-band of the output signal, where i = 1-N;

dividing the audio signal into the same N sub-bands and filtering an i^{th} sub-band of the audio signal, where i = 1-N;

determining a difference between the i^{th} filtered sub-band of the audio signal and the i^{th} filtered sub-band of the output signal;

adjusting the gain of an i^{th} equalizing filter of an adaptive graphic equalizer in response the difference between the i^{th} filtered sub-band of the audio and output signals, the equalizing filters having different center frequencies and spanning a predetermined audio bandwidth; and

generating an equalized audio signal and providing the equalized audio signal to the audio system.

10. The self-adaptive graphic equalization method, as set forth in claim 9, further comprising:

lowpass filtering an i^{th} sub-band of the filtered audio signal, where i = 1-N;

lowpass filtering an i^{th} sub-band of the filtered output signal, where i = 1-N;

Sub B1

mean normalizing the i^{th} sub-band lowpass filtered audio signals and the i^{th} sub-band lowpass filtered output signal and generating an i^{th} sub-band of mean-normalized audio signal and an i^{th} sub-band of mean-normalized output signals.

11. The self-adaptive graphic equalization method, as set forth in claim 10, further comprising:

comparing the i^{th} sub-band lowpass filtered output signal with the i^{th} sub-band of mean-normalized audio signal; and

adjusting the i^{th} sub-band of the graphic equalizer in response to the comparison.

12. The self-adaptive graphic equalization method, as set forth in claim 10, further comprising:

comparing the i^{th} sub-band lowpass filtered output signal with the i^{th} sub-band of mean-normalized audio signal; and

incrementing the i^{th} sub-band of the graphic equalizer in response to the i^{th} sub-band lowpass filtered output signal being less than the i^{th} sub-band of mean-normalized audio signal, or decrementing the i^{th} sub-band of the graphic equalizer in response to the i^{th} sub-band lowpass filtered output signal being greater than the i^{th} sub-band of mean-normalized audio signal.

Sub B'

13. The self-adaptive graphic equalization method, as set forth in claim 10, further comprising:

determining a difference between the i^{th} sub-band lowpass filtered output signal and the i^{th} sub-band of mean-normalized audio signal; and

adjusting the i^{th} sub-band of the graphic equalizer by the amount of the determined difference.

14. The self-adaptive graphic equalization method, as set forth in claim 9, further comprising:

computing a time averages of the plurality of filtered output signals and the plurality of filtered audio signals;

converting the time averaged plurality of filtered output signals and the time averaged plurality of filtered audio signals to dB space; and

adjusting the time averaged plurality of filtered output signals and the time averaged plurality of filtered audio signals in dB space so that:

$$\sum_i r_{Li} = \sum_i o_{Li}$$

where r_{Li} is the time averaged i^{th} filtered output signal in dB space, and o_{Li} is the time averaged i^{th} filtered audio signal in dB space.

15. The self-adaptive graphic equalization method, as set forth in claim 9, wherein filtering the plurality of audio and output signals comprises bandpass filtering the plurality of audio and output signals .

16. The self-adaptive graphic equalization method, as set forth in claim 9, further comprising:

generating sound from the equalized audio signal using a speaker; and

Sub B'

measuring the generated sound using a microphone.

17. The digital self-adaptive graphic equalization method, as set forth in claim 9, wherein adjusting the gain of an i^{th} equalizing filter comprises incrementing i from 1 through N.

Sub B1

18. A digital self-adaptive graphic equalization method to equalize the affects of a speaker-microphone system and the environment on an audio signal, comprising:

receiving an output signal from the audio system, the output signal being generated by the audio system in response to the audio signal;

dividing the output signal into N sub-bands and filtering an i^{th} sub-band of the output signal, where i = 1-N;

dividing the audio signal into the same N sub-bands and filtering an i^{th} sub-band of the audio signal, where i = 1-N;

time averaging the N sub-bands of the filtered output signal;

time averaging the N sub-bands of the filtered audio signal;

normalizing the time averaged N sub-bands of the filtered output signal and the time averaged N sub-bands of the filtered audio signal;

determining a difference between the i^{th} filtered sub-band of the audio signal and the i^{th} filtered sub-band of the output signal;

adjusting the gain of an i^{th} equalizing filter of an adaptive graphic equalizer in response the difference between the i^{th} filtered sub-band of the audio and output signals, the equalizing filters having different center frequencies and spanning a predetermined audio bandwidth; and

generating an equalized audio signal and providing the equalized audio signal to the audio system.

19. The self-adaptive graphic equalization method, as set forth in claim 18, wherein time averaging the N sub-bands of the filtered audio signal and the filtered output signal comprises:

lowpass filtering the i^{th} sub-band of the filtered audio signal, where i = 1-N; and

Sub B1

lowpass filtering the i^{th} sub-band of the filtered output signal, where i = 1-N.

20. The self-adaptive graphic equalization method, as set forth in claim 18, wherein adjusting the gain of the graphic equalizing filter comprises incrementing the i^{th} sub-band of the graphic equalizer in response to the i^{th} sub-band lowpass filtered output signal being less than the i^{th} sub-band of mean-normalized audio signal, or decrementing the i^{th} sub-band of the graphic equalizer in response to the i^{th} sub-band lowpass filtered output signal being greater than the i^{th} sub-band of mean-normalized audio signal.

21. The self-adaptive graphic equalization method, as set forth in claim 18, wherein adjusting the gain of the graphic equalizing filter comprises adjusting the i^{th} sub-band of the graphic equalizer by the amount of the determined difference.

22. The self-adaptive graphic equalization method, as set forth in claim 18, further comprising:

generating sound from the equalized audio signal using a speaker; and

measuring the generated sound using a microphone.